Resident and Residency Characteristics Associated With Self-reported Preparedness for Population Health Management

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BACKGROUND AND OBJECTIVES: Population health management (PHM) is an important function of primary care with potential to improve outcomes and decrease costs, but is also among the most difficult strategies to implement in both practices and residency training. Our objective was to determine resident and residency program characteristics associated with graduates' reported preparation to perform PHM.

METHODS: We used data from the American Board of Family Medicine (ABFM) Certification Examination registration questionnaire in 2014 and 2015 and ABFM administrative data. Resident PHM preparedness was assessed via a single, self-reported question. Bivariate analysis and logistic multilevel regression were performed to determine independent associations between characteristics and reported PHM preparedness. Odds ratios were converted to risk ratios given the high prevalence of the outcome.

RESULTS: Our sample included 6,135 residents from 442 family medicine residencies. Sixty-nine percent (n=4,240) reported being extremely or moderately prepared to perform PHM. No residency program characteristics showed an association with reported PHM preparedness. Resident characteristics independently associated with reported preparedness included being an international medical graduate (IMG) (RR=1.21 [1.07–1.35]) and of Hispanic ethnicity. Reporting greater preparedness to use health information tools, to lead quality improvement projects, and to provide care in different settings were also associated with reported PHM preparedness.

CONCLUSIONS: Similar to a study of practicing physicians, we found that IMGs are more likely to report preparedness to perform PHM. This suggests that elements of international medical education may better inculcate PHM principles, and that these elements could be used to produce physicians better prepared to manage population health.

(Fam Med. 2017;49(10):772-7.)

As the United States shifts toward providing value-based care, new models of health care delivery are being implemented nationwide. The concept of population health management (PHM) is growing in importance, as it underlies many changes in US health care such as Accountable Care Organizations, Clinical Integration Networks, and the Patient-Centered Medical Home (PCMH),[1] and is central to meeting the triple aim for health care: better quality, lower costs, and healthier populations.[2,3]

PHM is a process that utilizes patient data aggregation and analysis in order to manage a distinct population's health, which itself is defined as the "outcomes of a group of individuals, including the distribution of such outcomes within the group."[4] There is no standard and agreed-upon definition, but common PHM methods include patient registries for defined populations or diseases, identifying care gaps, performing risk stratification, and carrying out targeted interventions for high-risk patients.[1,5] Many people have identified the potential for these strategies to improve outcomes and reduce costs, and have even considered this potential inherent to the definition of PHM.[6,7] Indeed, past work has demonstrated the benefits of PHM in action, with studies indicating improvements in quality of care, cost of care, or both[8-10] with the utilization of PHM techniques.

PHM is increasingly important for existing practices, with the physicians most likely to perform PHM being female or international medical graduates (IMGs).[11] However, there are barriers to its

implementation. One study found that fewer than 40% of physicians practice PHM,[11] and participants in the National Demonstration Project rated PHM as among the most difficult PCMH components to implement.[12] Barriers to implementation are greater for rural clinics and critical-access hospitals due to the resources PHM requires.[13] However, considering their vital role in rural communities, the opportunities for rural hospitals to proactively perform PHM are great,[14] and the effects of PHM may be particularly important to these communities where health is poorer and health care spending higher.

Teaching PHM to residents will better prepare them to adapt to the changing health care landscape, but family medicine residency programs face difficulties implementing these changes due to competing educational demands, cultural barriers, and resource constraints.[15,16] Among residencies that have adapted their curricula to teach PCMH principles, PHM has been identified as the feature most difficult to implement.[17] Given the pervasive difficulties associated with PHM implementation during residency training and beyond, it is important to identify early educational factors that facilitate PHM preparedness. Therefore, while other studies have examined characteristics associated with performing PHM in practice, our objective was to identify resident and residency program characteristics associated with greater self-reported preparedness to practice PHM among graduating family medicine residents.

Methods

Data Source
We used data from the 2014 and 2015 American Board of Family Medicine (ABFM) Certification Examination registration questionnaires. A practice demographic survey is a mandatory part of the examination application, which is completed 3 to 4 months prior to taking the examination. Questions relate to intention to provide clinical

services and procedures, and preparation to practice certain primary care functions. For our outcome variable we used a question asking "How prepared are you to perform population health management?" Responses were: "not at all prepared", "somewhat prepared", "moderately well prepared", and "extremely well prepared". We created a dichotomous outcome combining the "moderately well prepared" and "extremely well prepared" responses vs "not at all prepared" and "somewhat prepared" for analysis. We also used data from other questions regarding preparedness to "use electronic and other information tools (eg, registries, decision aids) for managing population health", lead quality improvement projects, and provide care in different settings. Additional resident characteristics were obtained from ABFM administrative data. Site of undergraduate medical education was classified as United States and IMG, as prior research found an increased propensity for IMGs to perform PHM.[11]

Residency characteristics were derived from ABFM administrative data. First, we calculated the size of the residency by averaging the number of residents per training year in both 2014 and 2015, and categorizing to five or fewer, six to eight, and nine or greater. Next, we determined rural/urban location of the residency by linking the residency's mailing address ZIP code to the Rural Urban Commuting Area (RUCA) codes.[18] As fewer than 7% of residencies were in rural areas, we chose a dichotomous measure instead of using the full RUCA scale.

Data Analysis
We first analyzed our sample with descriptive statistics. Next, we investigated bivariate associations between all variables of interest and degree of self-reported preparation to perform PHM using t-tests and chi-square tests. Finally, due to the nested structure of our data (residents in residencies) we used multilevel logistic regression to determine

independent associations between each variable and self-reported preparation to perform PHM. Given the high prevalence of our outcome, odds ratios may overestimate the association between predictor variables and the outcome. We therefore converted odds ratios to relative risks.[19]

All analyses were conducted in SAS version 9.3 (Cary, NC). This study was approved by the American Academy of Family Physicians Institutional Review Board.

Results
Our sample included 6,135 residents from 442 family medicine residency programs. The majority of these respondents held an MD degree (81.5%) and were US medical graduates (66.1%, Table 1). Only 6.8% of residency programs were located in rural areas, and the majority of the programs were of moderate size, with six to eight residents per year. Because the questionnaire was a mandatory component of registration for the ABFM's certification examination, the response rate was 100%. Overall, 69% (n=4,240) of all respondents reported being either extremely or moderately prepared to perform PHM.

In bivariate analysis, resident characteristics positively associated with self-reported PHM preparedness (extremely or moderately prepared) included being over the age of 35, male gender, having an MD degree, and being of Hispanic ethnicity. Associations were also found with preparedness in other areas, such as the use of health information tools, leading quality improvement projects, and providing care in different settings ($P<0.05$). IMG status was also associated with PHM preparedness. Of those who reported feeling prepared to perform PHM, 36.9% were IMGs, while of those who reported feeling unprepared, only 27.2% were IMGs ($P<0.01$). Smaller program size was positively associated with PHM preparedness, though the rurality of a program was not (Table 2).

Table 1: Resident and Residency Characteristics of Respondents to the 2014 and 2015 American Board of Family Medicine Certification Examination Registration Questionnaire

Resident Characteristics (n=6,135)	
Characteristic	**Percentage or Mean (SD)**
Age at Residency Graduation	**32.9 (4.4)**
Over 35	23.0
Under 35	77.0
Sex	
Male	44.6
Female	55.4
Degree Type	
MD	81.5
DO	18.5
Undergraduate Medical Education	
United States	66.1
International medical graduate	33.9
Race	
White	65.8
Asian	25.0
Black/African American	7.5
Other	1.7
Ethnicity	
Non-Hispanic	92.1
Hispanic	7.9
Residency Characteristics (n=442)	
Residency Location	
Rural	6.8
Urban	93.2
Average Number Residents/Year	
5 or fewer	21.0
6-8	59.3
9 or more	19.7

In multilevel multivariate logistic regression models, variables found to be independently associated with self-reported PHM preparedness included age over 35 years (RR=1.18 [1.05-1.31]), being of Hispanic ethnicity (RR=0.63 [0.50-0.79]), and being an IMG (RR=1.21 [1.07-1.35]). Higher levels of self-reported preparation to use health information tools, to lead quality improvement projects, and to practice in different settings were also significantly associated with self-reported PHM preparedness (Table 2). Residency program size, gender, and MD degree, which were significant in bivariate analyses, became nonsignificant in these models.

Discussion

In a large national sample of graduating family medicine residents, we found significant associations between self-reported PHM preparedness and certain resident characteristics, but found no significant association between family medicine residency program size or location. We were particularly interested in the rurality of residency programs, as we suspected that rurally-located programs might address their unique needs and patient populations by strongly preparing residents to perform PHM. Our negative finding indicates that rural family medicine programs are doing as well as urban programs in terms of preparing family physicians for PHM, despite decreased resources and fewer health professionals. However, this also suggests that opportunities for rural programs, such as the benefits of PHM for their unique population

Table 2: Associations Between Resident and Residency Characteristics With
Preparedness for Performing Population Health Management

	Percentage Extremely/ Moderately Prepared (n=4,240)	Percentage Somewhat/ Not at All Prepared (n=1,895)	Relative Risk (95% Confidence Interval)
Age at Residency Graduation			
Over 35*	24.6	19.6	1.18 (1.05, 1.31)
Under 35	75.4	80.4	Reference
Sex			
Male	46.1	41.1	1.05 (0.96, 1.16)
Female	53.9	58.9	Reference
Degree Type			
MD	82.7	78.9	1.05 (0.93, 1.19)
DO	17.3	21.1	Reference
Undergraduate Medical Education			
United States	63.1	72.8	Reference
International medical graduate*	36.9	27.2	1.21 (1.07, 1.35)
Race			
White	65.9	65.6	Reference
Asian	25.1	24.6	1.03 (0.91, 1.17)
Black/African American	7.2	8.0	0.95 (0.78, 1.14)
Other	1.7	1.8	0.95 (0.63, 1.35)
Ethnicity			
Non-Hispanic*	91.2	94.0	0.63 (0.50, 0.79)
Hispanic	8.8	6.0	Reference
Residency Location			
Rural	4.98	4.43	0.84 (0.64, 1.08)
Urban	95.0	95.6	Reference
Average Number Residents/Year			
5 or fewer	11.1	9.8	Reference
6-8	59.0	57.0	1.00 (0.84, 1.18)
9 or more	30.0	33.3	1.01 (0.84, 1.15)
Use of Information Tools			
Not at all prepared*	0.2	3.4	0.39 (0.18, 0.79)
Somewhat prepared	2.9	23.0	Reference
Moderately prepared*	36.4	41.7	2.14 (1.94, 2.32)
Extremely prepared*	60.5	31.98	2.38 (2.21, 2.54)
Lead Quality Improvement Project			
Not at all prepared*	0.4	5.5	0.60 (0.38, 0.92)
Somewhat prepared	9.5	57.8	Reference
Moderately prepared*	60.8	33.2	2.59 (2.50, 2.66)
Extremely prepared*	29.3	3.6	3.03 (2.97, 3.08)
Prepared to Provide Care in Different Settings			
Not at all prepared	0.1	1.0	1.09 (0.31, 2.28)
Somewhat prepared	4.3	22.5	Reference
Moderately prepared*	44.3	47.4	1.57 (1.38, 1.78)
Extremely prepared*	51.3	29.1	1.67 (1.46, 1.88)

* Relative risk significant with $P<0.05$.

and the strong role of rural clinics and hospitals in their communities, are not leading to observed PHM benefits.

Residents who reported feeling prepared to perform PHM were also likely to report feeling prepared to use electronic health tools to manage population health, to lead quality improvement projects, and to provide care in different settings. One interpretation of these findings is that preparation to perform PHM may measure preparation in general. However, the proportion of residents reporting preparation for PHM was lower than other measures (69% vs 90-97%) and the magnitude of association between them varied, with providing care in different settings being weaker. We believe this indicates that these variables assess preparedness in different educational areas.

Notably, the areas of self-reported preparedness with the strongest association with PHM preparedness (using health information tools and leading quality improvement projects) are also relevant to PHM education, which may further explain this relationship. Our finding that using electronic tools to provide PHM and preparation for PHM were strongly correlated, is consistent with literature discussing health information tools as foundational components of PHM.[20] Prior work also found that physicians who practice PHM are also more likely to use electronic health tools such as an EHR.[11] Furthermore, past work reported that difficulties with the creation and use of patient registries was the major barrier for family medicine residents to perform PHM within the context of PCMH curricular changes.[17] This consistent, positive association between information health tools and PHM suggests that the support and improvement for information health tool education in residency programs may facilitate improvements in resident PHM education. Additionally, as quality improvement involves the systematic targeting of a particular problem within a certain patient population,[21] its process has been noted to be similar to that of PHM.[22]

Perhaps our most interesting finding was that IMGs were more likely to feel prepared to perform PHM, which supports earlier work that found IMG family physicians were more likely to perform PHM in practice.[11] Notably, nations such as Canada and the United Kingdom have made strong efforts to implement the principles of PHM into their undergraduate medical curricula. For example, Canada has worked toward implementing public health in their curriculum in response to the World Health Organization's Toward Unity for Health initiative,[23] and the UK has done the same following the General Medical Council's 1993 and 2003 calls for improved public health education.[24-26] Our finding combined with past data suggests that there is something unique about foreign medical education efforts to implement PHM that may be more successful than efforts made by United States counterparts, which continue to struggle to implement PHM into undergraduate training despite current efforts.[15-17]

While IMGs reported greater feelings of preparedness and also demonstrated increased propensity to incorporate PHM into their practice in a past study,[11] the same did not hold true for female respondents. Despite data showing that female physicians perform PHM more than their male counterparts,[11] female residents did not report greater feelings of preparedness to perform PHM. It is possible that this finding is explained by the gap between perceived preparation and actual practice. In addition, this gap may be exacerbated by women's tendency to have lower self-confidence than men, which may cause female residents to underestimate their own preparedness.[27,28]

Limitations of this study included the subjective nature of the survey question, "How prepared are you to perform population health management?" While our definition of PHM involves the use of data aggregation and subsequent analysis in order to manage the health of a defined population, respondents may have used different definitions of the phrase "population health management" when responding to the question. Respondents unfamiliar with PHM would likely have defined it as caring for the health of a distinct population, but may not have incorporated commonly accepted processes, such as using electronic tools for data aggregation and analysis, into their definition. Furthermore, this study only addressed residents' feelings of preparedness, which may not translate to actual ability to perform PHM. We lacked data on the curricula or clinical characteristics of residency programs, so we were unable to account for possible associations between features such as PCMH recognition of the family medicine center and resident PHM preparedness. Larger residencies would be more likely to have these features and the resources to have dedicated tracks or PHM curricula, but we found no association between residency size and resident PHM preparedness. Finally, this was a cross-sectional study outlining associations between residency characteristics and PHM preparedness, but it does not imply causation.

Looking forward, as the medical landscape of the United States continues to change, it will be increasingly important to identify ways to improve population health education in medical training. It is necessary to meet this challenge head-on, given studies reporting difficulties implementing PHM into both medical training and practice.[12,17] The results of this study support past work,[11] demonstrating an increased aptitude to manage population health among IMGs when compared to US medical graduates. As residency programs endeavor to produce physicians prepared to practice in a changing health care landscape, findings such as these suggest that examining the population health curricula of international medical schools may elucidate what modifiable factors

contribute to improved population health aptitude.

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